many of the species have hitherto been *peculiar* to the several strata. This is here shown.

	Vertebrata.	Encephala.	Lamellibranchs.	Brachiopods.	Polyzoa.	Echinoderms.	Articulata.	Actinozoa.	Amorphozoa.	Total.
Chalk.....	0	0	2	1	1	0	0	0	1	5
Upper Greensand	1	2	8	4	2	4	0	0	3	24
Gault.....	0	2	0	0	1	0	0	0	0	3
Hunstanton Rock	1	6	7	0	2	5	1	3	3	28

So far as life-evidence can be trusted, this table demonstrates the Hunstanton Rock to be Upper Greensand. With 24 Greensand species, and only 5 Chalk forms, and 3 Gault forms, the affinity of the bed with the latter deposits must be very slight, and need not be anything at all. Hence, and especially as most of them come from the middle of the stratum, the species *peculiar* to the Hunstanton Rock must be regarded as species peculiar to the Upper Greensand.

And when it is remembered how many of the fossils of most Greensand localities had previously only been known from the Chalk or Gault, the proportion here is singularly small. Even in this section there are 14 Greensand species which, since they are also Chalk species, may, at one period of our knowledge, have been peculiar to the Chalk; while there are 3 which, for the same reason, may have appeared to be peculiar to the Gault. Therefore there is *nothing* in the fossils to distinguish this deposit from the Upper Greensand of other localities: to the palæontologist the Hunstanton Red Rock is a northern extension of the Upper Greensand.

XXXIV.—*On the Influence of the Nervous System on the Respiration of Insects.* By E. Baudelot*.

The influence of the nervous system upon the respiration of Insects had attracted but little attention on the part of physiologists until, in 1860, M. Faivre undertook some interesting investigations upon this subject†.

The results of his researches led this naturalist to assume that in the *Dytici*, as in the Mammalia, the respiratory movements have their origin or starting-point in a special region of the

* Translated by W. S. Dallas, F.L.S., from the 'Comptes Rendus,' June 20, 1864, p. 1161.

† Annales des Sciences Naturelles, tome xiii.

nervous system, and that this region in the *Dytici* corresponded with the metathoracic centre or ganglion, the function of which would be to excite the respiratory movements and to coordinate and maintain them. On the other hand, he supposed the movements of the posterior part of the abdomen connected with respiration to be under the influence of the subœsophageal ganglion. The abdominal ganglia, from which the respiratory nerves originate, according to M. Faivre simply play the part of conductors in relation to the respiratory centre or metathoracic ganglion: after the separation of the thoracic centres, they cannot maintain respiration.

Having for some time particularly directed my attention to the comparative physiology of the nervous system, I was struck with the results at which M. Faivre had arrived, and with their complete discordance both with the notions generally entertained regarding the functions of the nervous system in the Articulata and with the previous experiments of M. E. Blanchard upon the nervous system of the Arachnida. I therefore resolved to take up the question; and as with *Dyticus* experimentation is difficult, and the results complex and consequently not very conclusive, I selected as the subject of my investigations a far more favourable insect, namely the larva of *Libellula*.

This larva, as is well known, possesses a nervous chain formed by a series of twelve ganglia, all perfectly distinct from each other. In it the metathoracic ganglion is united with the first abdominal ganglion by long connexions, enabling the two ganglia to be easily separated: in it, also, the respiratory movements are particularly easy of observation, betraying themselves in two different manners—namely, in the first place, by movements of depression and elevation of the inferior half-rings of the abdomen, and, secondly, by the alternate separation and approximation of the five appendages situated at the extremity of the last segment.

The following are the results of my experiments upon this larva. In my first experiment, I cut away the head at noon: respiration was continued with great regularity, twenty-six inspirations per minute being counted; at 6 o'clock P.M. the respiratory movements were still strong and regular; at 9 o'clock the next morning the respiration still persisted, although much weakened, and it was not quite extinct until 3 o'clock P.M. From this experiment we may conclude with certainty that the principle of action of the respiratory movements does not reside in the cerebral lobes: the destruction of the cerebroid ganglia, by suppressing the intervention of the will, appears only to modify slightly the rhythm of the respiration, which becomes less capricious and more regular.

In a second experiment, at 2 o'clock P.M., I made a ligature a little behind the metathorax, and effected the section of the body immediately in front of this. In this way I was quite sure that I had removed the metathoracic ganglion, which is situated at the centre of the space between the insertions of the second and third pairs of legs. At 4 o'clock, however, the number of respirations was eighteen per minute, and the respiration only presented a few irregularities; at 3 o'clock P.M. next day it was still possible to perceive some respiratory movements. To leave no chance of uncertainty, I dissected the portion of the body which I had cut away in front of the ligature: it contained the three thoracic ganglia as well as the first abdominal one.

In a third experiment, the ligature and section were made at the fifth segment of the abdomen, when the respiratory movements, although much weakened and rendered irregular, still persisted for more than twenty-four hours. Nevertheless the portion of the body anterior to the section contained the whole of that part of the nervous chain that extends from the head to the fifth abdominal ganglion.

From these two latter experiments it is quite evident that the metathoracic ganglion is not the prime motory focus of the respiratory movements, since, after the complete removal of this ganglion, respiration continued to be effected for a period of twenty-four hours. With regard to the subœsophageal ganglion, I have been unable to discover in it any special coordinative property; and when the respiratory movements were produced independently of its influence, I always saw the five appendages of the last abdominal segment concurring normally, as before, in the respiratory act with the whole of the other segments of the abdomen.

I repeated these experiments upon the adult *Libellula* with equally conclusive results. The complete section of the body behind the metathoracic ganglion does not cause the suspension of the respiratory movements in the portion posterior to the section, any more than in the larva. Thus in one case, in which I made a ligature and then a section behind the second segment of the abdomen, the respiratory movements persisted for eight hours; the inhalations, which were very regular, rose to fifty per minute, and yet the metathoracic ganglion had been cut away with the anterior portion. In another experiment, the respiration lasted seven hours; it was very regular, and the number of inhalations was sixty-five per minute.

Lastly, in a final experiment, I cut a piece out of the abdomen including only three segments (4–6); and in this I observed very appreciable movements of respiration for some time.

These results and others of precisely similar nature, which I

obtained with larvæ of a Dyticide (probably of the genus *Colymbetes*) appear to me to prove that in insects the respiratory movements are not, as in the Vertebrata, dependent on a special focus of innervation. On the contrary, each abdominal ganglion is a focus of motory innervation, and takes its part in the performance of the respiratory act in its totality. It is also important to remark that, after the section of the nervous chain, the isolated action of a ganglion appears to be weaker in proportion as this ganglion is united with a smaller number of other ganglionic elements.

Thus we see that in this case experiment only confirms what anatomy might lead us to foresee; for when we consider the distribution of the nervous element in the segments of the thorax and abdomen in the Articulata—when we see, in the Crustacea, the respiratory apparatus occupying the most diverse positions, sometimes on the thorax, sometimes on the abdomen, and receiving its nerves from the most different points, it is hardly possible to assume that in insects there is a single focus of innervation for the respiratory function.

XXXV.—*On Museums, their Use and Improvement, and on the Acclimatization of Animals;* being the Address delivered to the Zoological and Botanical Section of the British Association, at the Bath Meeting, by Dr. J. E. Gray, President of the Section.

Before entering upon the special business for which the Section has been called together, viz. the consideration of the Reports to be presented upon various zoological and botanical subjects, and the reading of the papers submitted by the members, I should wish to make a few general observations on some topics which appear to me to have an important bearing on the science which we study, in the hope that they may elicit some observations from the members present. I have always felt that one of the most important uses of the Association was the bringing together of so large a body of men engaged in kindred pursuits, and the consequent promotion of free personal intercourse between those who, not inhabiting the same locality or even the same country, were scarcely likely to meet except on such an occasion as the present. In such meetings the free interchange of thought by means of oral communication is most valuable; for it is in this way that facts are most readily brought into notice, and opinions most freely canvassed, that truth is most effectually elicited, and that erroneous or crude ideas are dissipated, corrected, and improved.

Some of my predecessors in this office have given a summary *résumé* of the recent progress of science in the departments over which I have now the honour to preside, and I had at first thought of attempting to follow their example; but I find myself precluded